



CONVENTION ON LONG-RANGE TRANSBOUNDARY AIR POLLUTION

WORKING GROUP ON EFFECTS

INTERNATIONAL COOPERATIVE PROGRAMME ON EFFECTS OF AIR POLLUTION ON NATURAL VEGETATION AND CROPS (ICP VEGETATION)

Minutes of the 19th Task Force Meeting

The nineteenth meeting of the Programme Task Force was held from 30th January to 2nd February, 2006, Caernarfon, Wales, United Kingdom.

1. The meeting was attended by 52 experts from the following Parties to the Convention: Austria, Belgium, Finland, France, Germany, Italy, Latvia, Lithuania, Norway, Russian Federation, Slovenia, Spain, Sweden, Switzerland, United Kingdom. In addition, the chairman and the secretary of the Working Group on Effects (WGE), two representatives from the ICP Forests, one representative from EMEP/MSC-West, one guest from India and one guest from South-Africa attended the meeting.
2. Mr H Harmens (chairman of the ICP Vegetation, UK) welcomed all participants on behalf of the ICP Vegetation Coordination Centre and thanked the UK Department for Environment, Food and Rural Affairs (Defra) and the Centre for Ecology and Hydrology (CEH) for supporting the meeting. Ms B Emmett (Head of site, CEH Bangor) welcomed the participants to North Wales on behalf of CEH and gave an overview of the five scientific programmes in CEH (biogeochemistry, water, biodiversity, climate change and sustainable economies). Ongoing research at CEH Bangor includes catchment science, biogeochemistry of carbon and nitrogen, sustainable use of resources, impacts of ozone on vegetation and biomonitoring of ozone and heavy metal pollution.
3. The Programme Task Force adopted the agenda of the meeting.
4. Mr H Gregor (chairman of the WGE) gave an overview of the status of work on the effects of major air pollutants on human health and the environment as discussed at the 24th session of the Working Group on Effects (31 August – 2 September 2005, Geneva) and other relevant developments. He highlighted major achievements of the ICPs, Task Force on Health and Joint Expert Group on Dynamic Modelling as presented at the 24th session of the WGE and thanked the ICP Vegetation for its valuable input to the work under the LRTAP Convention. The Convention intends to produce a new draft on data rules for its work, to be submitted to the Executive Body of the Convention in December 2006 for approval. Mr H Gregor concluded with summary statements related to work conducted for the Multi-pollutant multi-effect Protocol, Heavy Metals Protocol,

POPs Protocol and work regarding particulate matter (PM) and stressed the need for stable funding to ensure the success of the new long-term strategy of the WGE (2005-2015).

5. Mr M Johansson (secretary of the WGE) reported that Albania has joined the LRTAP Convention, which now has 50 Parties. He gave an overview of the organisation of the Convention and the eight Protocols, all in force and three under review. He stressed the importance of support to the participation of countries in the EECCA region (Eastern Europe, the Caucasus and Central Asia). He reported on the main draft conclusions from the Convention workshops on ozone and nitrogen in late 2005, including the workshop in Obergurgl, Austria (15-19 November) on 'Critical levels of ozone: further applying and developing the flux-based concept', in particular to consolidate its results in programmes' Task Force meetings. He gave an overview of the main outcome of the 23rd session of the Executive Body and informed the meeting that Mr M Williams (UK) is its new chair. Mr M Johansson concluded with a summary of the data requirements and priorities as set out in the new long-term strategy of the WGE.
6. Mr H Harmens (ICP Vegetation Coordination Centre, UK), Chairman of the ICP Vegetation, gave an overview of ICP Vegetation activities and achievements in 2005. He described the biomonitoring programmes for ozone damage on white clover and *Centaurea jacea* (brown knapweed) and showed that the ozone levels across much of Europe were lower in 2005 than 2004. Nevertheless, the concentration-based critical level of ozone for crops and (semi-)natural vegetation was still exceeded at ca. 80% of the biomonitoring sites, resulting in frequent occurrences of leaf injury on the biomonitors in 2005. He continued with a summary of the outcome of the discussions in the three working groups (forest trees, semi-natural vegetation and crops/application of flux-based models) at the ozone critical levels workshop in Obergurgl. Mr H Harmens reported on the current status of the European heavy metals in mosses survey 2005/6 and informed the meeting that 32 Parties to the Convention participate, collecting mosses from ca. 7000 sites. In addition, 17 Parties to the Convention will determine the nitrogen concentration in the mosses at ca. 3200 sites. For lead he showed that its concentration in mosses had decreased in general between 1990 and 2001. The ICP Vegetation moss data base was used for the first time by EMEP/MSCEast to verify the performance of the EMEP deposition model. For lead significant positive correlations were observed between the modelled total deposition and the concentration in mosses, in particular for areas in Scandinavia that are not influenced by local emission sources (see EMEP/MSCEast Technical Report 8/2005, available from <http://www.msceast.org>). Mr H Harmens showed encouraging examples of the application of mosses as biomonitors of atmospheric nitrogen deposition for Scandinavian countries, reported on the trends of the nitrogen concentration in herbarium moss samples for selected European countries (1829-2000) and discussed potential confounding factors in the use of mosses as biomonitors of atmospheric nitrogen pollution. Finally, he listed the reports and publications produced by the ICP Vegetation Coordination Centre during 2005, informed the meeting that all deliverables to the WGE in 2005 were achieved, described the ICP Vegetation work plan for 2006 and reported on developing areas. He thanked the UK Department for Environment, Food and Rural Affairs

for their continuing financial support to the ICP Vegetation Coordination Centre and the participants for all their contributions to the programme.

7. Ms M Sanz (Spain) and Mr M Schaub (Switzerland) represented the ICP Forests Working Group on Air Quality and gave an overview on the work conducted during the three-year test phase (2001-2003) on the relationship between passive monitoring of the atmospheric ozone concentration and visible leaf injury in trees and shrubs. Based on the surveys on ozone injury and concentrations carried out in the Level II plots of the ICP Forest Pan European network, the ozone visible injury and high levels of ozone are widespread. However, despite the frequent occurrence of visible leaf injury and the observed relatively high concentrations of ozone, it is still difficult to establish a relationship between both. A significant role of ozone as predictor of defoliation was identified and the potential of using ICP Forests Level II data for flux modelling was verified and offered to ICP Vegetation in case it is interested in collaborating in this field. The 20th ICP Forests Task Force Meeting (Rome, 2005) adopted the continuation of ozone concentration measurements at ICP Forests Level II plots for another three years (2006-2008) using passive sampling with a reference exposure period of 14 days. The Working Group on Air Quality offered the collaboration with the ICP Vegetation and the ICP Modelling and Mapping regarding ozone exposures and ozone risk assessment, including symptom assessment and ozone flux modelling.
8. Ms G Mills (ICP Vegetation Coordination Centre, UK), Head of the Programme Centre, gave an overview of ozone research conducted at CEH. Ozone research at CEH Edinburgh includes measurements of ozone fluxes to vegetation (both stomatal and non-stomatal) applying the Eddy Covariance technique and mapping of ozone concentrations and fluxes in the UK. Ozone research at CEH Bangor includes quantifying the effects of the changing ozone profile (increasing background and reduced peak concentrations) on upland vegetation using solardomes, population-specific responses of *Anthoxanthum odoratum* to ozone (growth, plant physiology and molecular genetics), impacts of ozone on wetlands (plant physiology, carbon cycling, microbial processes) and predicting ozone-sensitive communities at the European scale using the ICP Vegetation database (OZOVEG).
9. The following presentations reported on areas of research that the ICP Vegetation would like to develop further in the future: reporting to the Convention on impacts of nitrogen on vegetation and links with air pollution networks outside the ECE region. Ms B Emmett (UK) gave an overview of the impacts of nitrogen deposition on vegetation. In many areas in the UK the current nitrogen deposition rate is 20 kg ha⁻¹ y⁻¹ or more. The critical load approach indicates that currently 55% of the UK habitat is at risk from nitrogen pollution. Surveys and experimental work indicate that a major shift in species composition has already occurred, i.e. towards species with a higher fertility score. The further development of dynamic models will be key to forecasting impacts of clean air policies. Ms L Emberson (UK) gave an update on the RAPIDC (Regional Air Pollution In Developing Countries) project and discussed in more detail APCEN (Air Pollution Crops Effect Network). She presented plans for a provisional risk assessment and the use of white clover as biomonitor of ozone pollution in southern Africa and South-Asia (biomonitoring work has already started in South-

Africa). Ms M Agrawal (India) gave a presentation on 'Air pollution and agriculture: an Indian scenario'. After information on the major pollution sources and trends in air pollutant concentrations in India, she described the major approaches to air pollution research with crops (surveys, long-term field studies and experimental exposure studies) and presented some results in more detail. Ozone poses the greatest threat to agriculture in India and she emphasized the need for yield response relationships (applicable in various environmental conditions) and the need to develop bioindicator protocols for impact evaluation. Mr G Krüger (South Africa) followed with a presentation on 'Air pollution in South Africa with reference to quantification of the impact of C2-hydrocarbons'. He reported on the main pollution sources in southern Africa, impacts on vegetation (e.g. trichloroacetic acid concentrations in leaves) and quantification of those impacts. There is very little conclusive evidence of air pollution damage in southern Africa. An ozone biomonitoring study with white clover has started in South-Africa.

10. Sixteen posters were presented at the meeting. These showed the results of a variety of ozone themes, e.g. results of ozone biomonitoring studies with white clover, the use of Ellenberg numbers in predicting ozone sensitivity of plant species, impacts of ozone (and interactions with nitrogen) on Mediterranean crop yield, impacts of ozone on hedgerow communities, experimental approaches to detect early ozone injury, short-term critical levels of ozone. Regarding heavy metals/nitrogen, results were presented on the temporal trends (1990-2001) of heavy metals in mosses across Europe, copper accumulation and defence mechanisms in lichens growing on copper-rich rock and mosses as bioindicators of nitrogen deposition.
11. The meeting split into parallel sessions considering the ozone and heavy metals/nitrogen sub-programmes.
12. Ms G Mills (UK) opened the ozone session with an introduction to the aims of the 'post-Obergurgl' session in which developments since the Obergurgl Workshop were discussed and a procedure for updating the LRTAP Convention Mapping Manual was agreed. The chairs/rapporteurs of the three working groups in Obergurgl summarised the outcome of the ozone critical levels workshop: Mr PE Karlsson (Sweden) reported on forests, Mr M Ashmore (UK) on semi-natural vegetation and Mr H Pleijel (Sweden) on crops/application of flux-based models. Three presentations followed to streamline and aid further discussion on ozone critical levels. Mr D Simpson (EMEP/MSC-West) gave a presentation on 'European-scale modelling: implications for flux approaches' in which he clarified the needs of the various users of flux-based methods, which were also distributed on paper titled 'Suggestions for large-scale modeling and IAM requirements concerning AOT and/or fluxes'. It was followed by Ms L Emberson (UK) with a presentation on 'Evaluation of the DO₃SE model for crops and application at the European scale' and Mr H Pleijel (Sweden) reported on 'A simplified flux-based method for Integrated Assessment Modelling'.
13. The ozone session continued with discussions on possible changes to the ozone critical levels for vegetation as described in chapter 3 of the LRTAP Convention Mapping Manual and the timescale for implementation of these changes. A full

description of the decisions made is provided in Annex I. In summary, it was agreed that for integrated assessment modelling, generic flux models would be developed for crops (one model applied to all of Europe) and trees (one model for Mediterranean Europe, one for other areas) and that changes would be made by drafting teams (see Annex I) and presented for incorporation in the Mapping Manual as an annex in time for the ICP Modelling and Mapping Task Force Meeting in April, 2006.

14. Mr I Gonzalez-Fernandez (Spain) described how genetic variation in stomatal conductance introduces uncertainty in Pan-European ozone risk assessment. Ms V Picchi reported on photosynthetic responses of two wheat varieties exposed to chronic ozone fumigation. Mr PE Karlsson (Sweden) presented results of an economic assessment of ozone impacts on vegetation in Sweden, followed by Mr M Holland (UK) who presented results of an economic assessment of crop losses from ozone exposure in Europe which included an analysis of uncertainty in the use of AOT40-based dose-response functions.
15. The ozone session continued with presentations and discussions on ozone biomonitoring experiments. Ms F Hayes (ICP Vegetation Coordination Centre, UK) gave an overview of the results of the ICP Vegetation biomonitoring experiments with white clover and brown knapweed, followed by a presentation from Mr J Fuhrer (Switzerland) on progress with the micropropagation technique of brown knapweed and plans for a pilot study in 2006. The session included a discussion on the requirements and plans for ozone biomonitoring experiments in 2006 and beyond. It was agreed that during the next two years, effort would be placed on collating evidence for effects of ozone on crops and semi-natural vegetation in the ECE region with the aim of producing a glossy report in 2008. This would involve a review of the literature, an in depth analysis of the results ICP Vegetation ambient air experiments and an assessment of evidence existing within national surveys and assessments that are not widely available. Participants from each of the five climatic regions agreed to assist in the collation of such data. These were: Mr B Gimeno or a colleague (West Mediterranean), Mr F Batic (East Mediterranean), Mr J Fuhrer (Continental Central Europe), Ms F Hayes (Atlantic Central Europe) and Mr H Pleijel and Mr P Karlsson (Northern Europe). An offer of assistance from the ICP Forests representative, Ms M Sanz, was gratefully received.
16. Ms G Mills (UK) informed the ozone group and subsequently the Task Force in plenary that regrettably, because of the extra time involved in preparing the evidence report, the ICP Vegetation Coordination Centre could no longer send plant material and equipment to participants that had a poor record in returning data. In future, pollutant and climate data could only be processed if received as a complete season-long file in the Excel format requested by the Coordination Centre, with filled gaps clearly identified within the file.
17. Mr E Steinnes (Norway) opened the heavy metals/nitrogen session with a presentation on 'Long-range atmospheric transport of trace metals to Norway as evident from moss analysis and other studies'. Mr E Kubin (Finland) followed with a presentation on 'The development of specimen banking and database for heavy metal surveys in Finland' and Mr R Pesch (Germany) reported on

‘Classification and regression trees relating metal accumulation in mosses with site specific and regional land characteristics’.

18. Mr H Harmens (UK) gave an introduction to the data rules that currently apply to work conducted under the LRTAP Convention (see ECE/EB.AIR/42, annex V) and which are relevant to the ‘heavy metals in European mosses database’. Currently the data provided to the ICP Vegetation Coordination Centre by the participants are not made available for use outside the Convention without the approval of the relevant participant. However, as the objective of the effect-oriented activities is to supply the best available data to Parties for the negotiations of Protocols in a transparent way, the Working Group on Effects (WGE) is currently reviewing its data rules for discussion at the Extended Bureau of the WGE (1 - 3 March 2006, Geneva, Switzerland) and the 25th session of the WGE (30 August – 1 September 2006, Geneva, Switzerland). Mr H Harmens will seek further advice from the participants of the moss survey in preparation for the discussion on data rules at the 25th session of the WGE. During the discussion in Caernarfon mixed opinions were aired on enhancing the public availability of the moss data.
19. Ms M Frontasyeva (Russian Federation) informed the heavy metal session about the outcome of air pollution studies in Macedonia using the moss biomonitoring technique, NAA, AAS and GIS technology, followed by a presentation from Ms A-M Rusu (UK) on ‘Investigating biogeochemical signatures in lichens and other environmental samples immediately following closure of a major polluting source in Romania’.
20. Mr H Harmens (UK) gave an update of the status of European moss survey 2005/2006, followed by a general discussion on data requirements and further processing. Currently 32 countries are participating in the heavy metals in mosses survey and more than half of the participating countries (17) have indicated that they will determine the nitrogen concentration in mosses as well. Mr E Steinnes (Norway) suggested to include antimony in the moss survey as a good indicator of heavy metal pollution from anthropogenic sources, which was accepted by the other participants. Data for the moss reference material (including nitrogen) will be further processed by Mr E Kubin (Finland) and Mr E Steinnes (Norway) for quality assurance purposes and countries were encouraged to participate in cross-border calibration exercises with neighbouring countries. Based on results of the interlaboratory calibration exercise with certified moss reference material, it was agreed that obvious outliers will be excluded from further data processing. The heavy metal sub-group suggested to include the 90th percentile of median values for each metal in the report of the 2005/6 moss survey and decided that only EMEP maps (50 km x 50 km grids) will be presented in the report and no ‘dot maps’. Mr H Harmens will remind all participants via e-mail about the data requirements for the European moss survey 2005/6, as described in the moss monitoring manual (see <http://icpvegetation.ceh.ac.uk/publications.htm>).
21. Ms Z Jeran reported on ‘Nitrogen concentrations and $\delta^{15}\text{N}$ in Hypnum cupressiforme collected in 2001 survey in Slovenia’, followed by a detailed presentation from Mr H Harmens (UK) on the use of mosses as biomonitors of nitrogen pollution in Europe (see paragraph 6 for further details). Data presented

as a poster by Mr J Santamaria (UK) indicated that short- and long-term temporal trends in the nitrogen concentration in mosses might be confounded by high spatial variability of the nitrogen concentration in mosses. The sub-group agreed on further developing the work on mosses as biomonitors of atmospheric nitrogen deposition.

22. Mr L de Temmerman (Belgium) reported on heavy metal deposition (arsenic, cadmium, lead and mercury) and the potential contamination of food crops and Mr H Harmens (UK) finished with a presentation on the temporal trends of heavy metals in mosses (1990 – 2001) in comparison with temporal trends in anthropogenic emissions and measured wet depositions for the metals cadmium, lead and mercury. In general, the lead concentration in mosses across Europe had decreased more with time than the cadmium concentration in mosses, in agreement with the emission and wet deposition trends reported by EMEP/MSC-East (see EMEP/MSC-East Technical Report 8/2005, available from <http://www.msceast.org>). For mercury not enough data were available for mosses to identify clear temporal trends. The group stressed and acknowledged the importance of the close collaboration with EMEP/MSC-East.
23. In the final plenary session Mr H Harmens (UK) gave a brief overview of the presentations and the outcome of discussions in the heavy metal/nitrogen sub-group (as described above), followed by brief summary from Ms G Mills (UK) on the conclusions and recommendations from the discussion in the ozone sub-group (as described above and in Annex I). The meeting took note of the conclusions and recommendations of the heavy metal/nitrogen and ozone sub-groups. The Task Force took note of the ICP Vegetation work plan and the agreed deliverables to the WGE for 2006 as described in document EB.AIR/WG.1/2005/4/Rev. 1 (see Annex II). The meeting revised the objectives for the programme as indicated in Annex III. Mr M Johansson, secretary of the WGE, emphasized the need to streamline work plans and deliverables within the WGE and the LRTAP Convention. Therefore, the Task Force will consider in the future how it can translate its objectives into a medium-term work plan (3 years) with concrete deliverables to the Convention. It decided to present its current and following year's work plan in the format requested by the Convention.
24. Ms M Frontasyeva (Russian Federation) kindly offered to host the 20th ICP Vegetation Task Force Meeting in Dubna (Moscow Region), which was gratefully accepted by the Task Force. The meeting was provisionally scheduled for the middle of March 2007. Mr H Harmens (UK) closed the meeting by thanking his colleagues of the ICP Vegetation Coordination Centre for organising the meeting and their contributions to the programme, the UK Department for Environment, Food and Rural Affairs (Defra) and the Centre for Ecology and Hydrology (CEH) for financially supporting the meeting and the ICP Vegetation and last but not least the participants for their continuing support of the programme.

ANNEX I

19th Task Force Meeting of the ICP Vegetation Ozone Flux Modelling Discussion (31 January, 2006) Summary of Key Decisions

Needs of users – Large scale modelling using flux models for generic species

In response to the points raised by CIAM & EMEP, the group decided that for use by Integrated Assessment Modelling within the RAINS model of IIASA:

- Risk based on generic AF_{st}Y models should be used for trees and crops (comparable to application of SOMO35 approach for health effects);
- AOTX-based critical levels should be used for semi-natural vegetation;
- A generic AF_{st}3 crop flux model will be developed using simplified wheat parameterisation, but having a longer accumulation period of three months;
- For trees, two AF_{st}1.6 generic models would be developed, one for deciduous species which would use the beech parameterisation as a starting point and one for evergreen species to be parameterised for application to the Mediterranean area. The details of the parameterisation for these models would be decided within the Forests sub-group;
- All three generic models would use latitude or temperature models for growing seasons and a long accumulation period;
- The text related to generic flux models and new semi-natural vegetation will be provided in an Annex to Chapter 3 of the Mapping Manual;
- Decisions on parameterisation of the generic flux models will be included in the Annex.

Needs of users – Local, national and regional scale

Default parameterisations of the full flux model for selected crop and forest species are currently included in the Mapping Manual within the critical levels text. It was decided that a note would be added to the Mapping Manual that local/national/regional parameterisations may be used for application at these geographical scales, but that the details of such parameterisations would not be included in the Mapping Manual in the proposed revision.

Guidance on appropriate EUNIS categories to use for the species/communities identified in the critical levels text will be added to the Mapping Manual.

Include parameterisation for individual species in ICP Vegetation Annual Report.

Procedure for making the annex to the Mapping Manual

It was agreed that the following groups would be responsible for the revision process:

Editorial group

- Liaise with ICP M&M, ICP Forests, EMEP, CIAM & WGE Secretariat
- Insert text changes
- Finalise text

Receptor-specific Advisory Groups

- Parameterisations for the generic species
- EUNIS land-use categories that can be used for each representative and generic species
- Suggest text changes for Mapping Manual

	Lead person	Members
Editorial Group	Gina Mills	Per Erik Karlsson, Hakan Pleijel, Mike Ashmore.
Forest tree advisory group	Per Erik Karlsson	Ben Gimeno; Maria Sanz; Gaby Deckmyn; Lisa Emberson; Marcus Schaub; Sabine Braun; Gerhard Wieser; Marco Ferretti; Håkan Pleijel; Mark Broadmeadow.
Crop advisory group	Håkan Pleijel	David Simpson, Lisa Emberson, Ben Gimeno or colleague.
Semi-nat. veg. advisory group	Mike Ashmore	Jürg Fuhrer, Gina Mills.

Changes in Mapping Manual to be circulated to all participants for comments.

Timescale for implementing changes to Chapter 3

2006	Deliverables
Discussed at ICP Vegetation TFM	Workshop report, summarising key decisions.
Confirmation of ICP Modelling and Mapping TFM (5 -7 April)	New annex for Mapping Manual chapter 3. Sub-groups to agree changes by end of Feb, and circulate for comment within relevant ICPs. Circulation of draft Mapping Manual annex in mid-March for ICP M&M delegates.
Presented at ICP Forests TFM (22-24 May)	Meeting acknowledged unfortunate timing and agreed that forest sub-group decisions would be circulated to ICP Forests members for comment at all stages in the revision process.
Noted by Working Group on Effects and recommended for use (30 Aug – 1 Sep)	Report.
Noted by Executive Body (11-15 Dec)	

ANNEX II: Work plan of the ICP Vegetation for 2006
(EB.AIR/WG.1/2005/4/Rev. 1)

Items common to all ICPs	Ozone	Heavy Metals	Nutrient N
<ul style="list-style-type: none"> • Report on support of effects-based approaches for the review and possible revision of the Convention protocols (to be defined by the Working Group on Strategies and Review); • Summary report of current information on dose-response functions and stock at risk; • Review report of links between field observations and critical loads. 	<ul style="list-style-type: none"> • Report on the extent of ozone damage to ozone-sensitive species of crops and (semi-) natural vegetation in 2005 using standardized experiments; • Refined maps of exceedances of critical ozone levels, based on the new critical levels of ozone (with EMEP/MSC-West); • Report on the impacts of ozone on vegetation in a changing climate; • Interim report on risk assessment and mapping procedures for communities of (semi-) natural vegetation at risk from ozone; • Proceedings of the workshop: “Critical levels of ozone: further applying and developing the flux-based concept”. 	<ul style="list-style-type: none"> • Report on the temporal trends in the European heavy metals in mosses database. 	<ul style="list-style-type: none"> • Report on the long-term (about 100 years) temporal trends in the nitrogen concentrations in mosses using herbarium material; • Report on the interactive impacts of ozone and nitrogen on crops and (semi-) natural vegetation;

In addition:

- Nineteenth meeting of the Programme Task Force to be held in Caernarfon, United Kingdom, from 30 January to 2 February 2006.

ANNEX III: Objectives of the ICP Vegetation
(Updated 1-2-06)

Long-term objectives

1. To meet the requirements of the UNECE Convention on Long-range Transboundary Air Pollution for information on the responses of (semi-) natural vegetation and crops to atmospheric pollutants.
2. To evaluate data on the responses of (semi-)natural vegetation and crops to air pollutants to validate the critical levels and methods defined in the mapping manual and to show the effects of exceedance.
3. To provide information for the further development of effects-driven protocols with respect to (semi-)natural vegetation and crops.

Short- and medium-term objectives

1. To validate maps of exceedance and risk by monitoring the impacts of ambient ozone on various crops and (semi-)natural vegetation.
2. To produce a state of knowledge report on evidence of impacts of ambient ozone in the ECE region.
3. To further develop and apply the concept of concentration-based and flux-based methods and critical levels of ozone for crops, (semi-)natural vegetation and trees.
4. To produce maps of exceedance of the revised ozone critical levels and risk (in collaboration with ICP Forests, EMEP/MSC-West and the ICP on Modelling and Mapping).
5. To provide further information on response functions and land cover for use in an economic assessment of crop losses due to ozone.
6. To conduct literature reviews and specific experiments to provide further information on the critical levels for, and risk of damage by, air pollutants for selected plants, plant communities and biodiversity.
7. To conduct literature reviews and experiments on the accumulation of atmospheric deposition of heavy metals by vegetation and the transfer of heavy metals into the human food chain (in collaboration with TF Health).
8. To conduct the 2005/6 survey of heavy metal and nitrogen concentrations in mosses in Europe.
9. To investigate methods for estimating and mapping heavy metal deposition from the heavy metal concentration in mosses data (in collaboration with EMEP/MSC-East).

10. To study the spatial and temporal trends in the atmospheric deposition of nitrogen by determining the nitrogen concentration in mosses.
11. To review the literature on, and conduct studies of, the interactions between ozone and nitrogen.
12. To consider the possibility of including within the programme experimental and modelling work on the effects of ozone on vegetation in a changing climate.
13. To consider the feasibility of including nutrient nitrogen effects on (semi-) natural vegetation within the programme of work.
14. To collaborate on air pollution effects research outside the UNECE region (e.g. Asia and southern Africa).